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REACTIONS PRODUCED BY NEUTRONS IN HEAVY ELEMENTS¹

By Dr. ENRICO FERMI

PROFESSOR OF PHYSICS, COLUMBIA UNIVERSITY

THE nuclear reactions produced by neutron bombardment in heavy elements can be conveniently described, according to Bohr, with the assumption that, as soon as the bombarding neutron strikes the nucleus, it is incorporated into the nuclear structure with the formation of the so-called compound nucleus. This is a relatively stable system in the sense that its lifetime is very long compared with the frequencies of nuclear particles; in an absolute sense, however, the lifetime is very short, being sometimes of the order of 10^{-12} seconds and sometimes much less.

The ultimate result of the nuclear reaction depends

¹ Presented in a symposium on "Nuclear Physics," at the University of Pennsylvania Bicentennial Conference, September 19.

upon the way in which the compound nucleus further disintegrates. And this mode of further disintegration depends in its turn, for any given nucleus, essentially upon the energy content of the compound nucleus. When the bombarding neutrons are slow the energy of the compound nucleus is equal to the binding energy of the neutron in the nucleus. Apart from irregular fluctuations from nucleus to nucleus, this binding energy has a general variation with the atomic number and is a maximum for elements of atomic weight about 40 where it is in the average about 9 Mev. From there on it decreases more or less regularly up to the heaviest elements where it attains an average value of about 5 Mev. If the bombarding neutrons

are fast, their kinetic energy must be added to the binding energy to obtain the total excitation energy of the compound nucleus.

The compound nucleus can lose its excitation energy by emission of some particle (neutron, proton, alpha particle or photon) or, in the case of the heaviest elements, thorium, protoactinium and uranium, it may disintegrate by fission into two approximately equal parts. Apart from this latter case, the most probable processes for medium weight and heavy elements is the emission of photons and of neutrons. Emission of protons and of alpha particles requires a much greater energy on account of the Gamow barrier of potential that the particle must overcome before coming out of the nucleus. Furthermore, in a nucleus containing one hundred or more particles, even when this energy is available, it is unlikely that it should all be concentrated in one single alpha particle or proton in order to give to it a sufficient energy to escape from the nucleus. It is much more probable that a neutron should be emitted instead, since a much lower concentration of energy is sufficient in this case.

The relative probability of the emission of a photon or of a neutron depends mainly on the energy. When the energy is barely larger than the binding energy of the neutron, as in the case of bombardment with slow neutrons, a photon is usually emitted. If instead the energy of the compound nucleus exceeds by a considerable amount the binding energy of the neutron, as in the case of bombardment with fast neutrons, the emission of a neutron from the compound nucleus becomes the most probable process. Even when the excess of energy is very large it is improbable that the outgoing neutron carries away all the energy that is available; indeed one can expect theoretically that the escaping neutron has a small probability to come out with an energy in excess of 2 Mev. In most cases, therefore, the nucleus remaining after one neutron has been emitted by the compound nucleus will still be in an excited state. The emission of one or more photons or, when the residual excitation energy is sufficient, of a second neutron ($(n, 2n)$ -reaction) will then occur before the nucleus reaches a stable configuration.

Compound nuclei of the very heaviest elements may also disintegrate by fission. This form of disintegration is made possible by the large amount of energy released by splitting a heavy nucleus into two approximately equal parts. In this respect we may say that all heavy nuclei are unstable. Their practical stability is, however, insured by the fact that the two fission fragments must overcome a practically impassable Gamow barrier for separating. In the case of uranium and thorium the height of this barrier is not so large any more and what prevents spontaneous fission is probably the large mass of the fission fragments which gives a very low penetrability even to a barrier which

is not very high. The relatively low excitation due to the arrival of a neutron is sufficient in these cases to excite the compound nucleus in a state above the top of the potential barrier or so near the top that the fission process becomes possible. It should be noticed in this respect that the bare extension of the Gamow mechanism of the potential barrier is probably not the only one that is responsible for the high stability of uranium with respect to the fission process: probably also other factors, as, *e.g.*, the low probability that the nucleus should take such a configuration as to make possible the transition into two fragments, play an important role in ensuring this stability.

It follows from this discussion that the most probable types of nuclear reactions in heavy elements under neutron bombardment are the following:

(n, γ) , produced especially by slow neutrons.

$(n, 2n)$, produced only by very fast neutrons.

Fission produced only in the heaviest elements by fast and, in one case, also by slow neutrons.

Uranium is a typical example of this behavior because in this element all three types of reactions are observed. The (n, γ) reaction was discovered by Hahn and Meitner, who recognized that among the active products produced in uranium by neutron bombardment one, with a period of 23 minutes, produced by a typical resonance process, is carried by an isotope of uranium. The assignment of the atomic weight of this isotope as 239 has been confirmed by direct experiment by Nier, Booth, Dunning and Grosse. U^{239} disintegrates into an isotope of element 93, which is also radioactive with a period of 2.3 days as proved by the investigation of Abelson and McMillan. When uranium is bombarded with very high energy neutrons an $(n, 2n)$ -reaction may take place whose final result is the formation of an isotope 237 from the main isotope 238 of uranium. This nuclear reaction has been recently reported by Nishina and others by McMillan; they found for this isotope a period of 7 days. The most interesting reaction produced by neutrons in uranium is the fission process, which occurs both in the isotope 238 and in the rarer isotope 235.

Since the fission process has been the object of many discussions I shall limit myself to the consideration of only one aspect of this phenomenon. The chemical investigation of the radioactive products of fission has proved the existence of a very large number of radio-elements indicating that the fission can occur in a number of different ways. We are thus led to the conclusion that after the compound nucleus is formed by adding a neutron to uranium the actual splitting of the nucleus may lead to different pairs of fragments; each one of them gives rise to a chain of radioactive elements having in the average 3 or 4 elements. It has been early recognized that the simple

theory of the fission process fails to represent correctly the results in so far as the splitting does not occur into two equal fragments but rather into fragments in which one is somewhat lighter and one is somewhat heavier. We have therefore to distinguish between a light and a heavy group of fragments. Presumably a fragment belonging to the light group and a fragment belonging to the heavy group are emitted in the same act. The problem arises now to determine what percentage of the fissions of uranium gives rise to the formation of a certain radioactive product or rather of a certain radioactive chain. Since it is expected that in every fission a chain belonging to the heavier group and a chain belonging to the lighter group are formed we would expect a total percentage of 100 per cent. for each of the two groups, except for the improbable direct formation of a stable fission fragment. Since very little quantitative information is available as to the relative intensities of the various fission products, Anderson, Grosse and I undertook last spring a systematic investigation of this problem. Our purpose was to make a preliminary survey, and the results obtained so far cover most of the known

radio-elements of the heavy group. The method used consisted in comparing the intensities of various radioactive products obtained by chemical separations from uranium samples irradiated under standard conditions and for a known length of time with the Columbia cyclotron. A known fraction of each radio-element was separated and brought near a counter; the activity was deduced from the number of counts, corrected in order to take into account the absorption by the counter walls and the various geometrical factors. We have thus been able to assign the percentage of fissions of most of the chains of reactions belonging to the heavy group. They vary from a minimum of about .1 per cent. to a maximum somewhat over 10 per cent. The percentages found so far for the heavy group do not add to a sum of 100 per cent. but rather to about one half of that. Apart from experimental errors, which can be quite considerable in measurements of this kind, this fact is probably due to the incomplete chemical investigation of this group. They indicate that probably some more radioactive elements of the heavy group, possibly belonging to the rare earths, have yet to be discovered and analyzed.

MENTAL HEALTH¹

By Dr. ADOLF MEYER

THE JOHNS HOPKINS HOSPITAL

THE symposium on Mental Health before the American Association for the Advancement of Science, December, 1938, is a document of considerable interest and importance to a wide range of students, workers and organizers.

It is brought before us by the original organizer of the program, Walter L. Treadway, assistant surgeon-general in the Department of Public Health, assisted by Nolan D. C. Lewis, director of the New York Psychiatric Institute—connected with the Columbia University Medical Center; Abraham Myerson, the head of a research group in the Boston State Hospital; a statistician in this domain in the person of Joseph Zubin, of the New York Psychiatric Institute; Harry Stack Sullivan, for years active in bringing anthropology and the study of personality together under a lead of psychiatry; Clarence M. Hincks, then the head of both the United States and the Canadian National Committees for Mental Hygiene, and Franklin G. Ebaugh, who has done so much for the organization of psychiatric education, in charge of the pertinent division of the National Committee, and head of the

psychiatric department of the Colorado University Medical School and Hospital.

The chairman, Dr. Treadway, had devoted several months almost exclusively to preparation for this contribution to a great public health problem in order to make the undertaking a model of its kind. The result presents mental health—as a major public health problem, as a major issue for American scientists, as a vital concern of society—in a symposium as carrier of a broad orientation properly belonging before the forum of all the sciences.

The symposium is presented in eight main chapters, but actually in six special sessions of Section N of the congress, the last chapter, under the title of "Human Needs and Social Resources," being presented to the whole congress as the final address by a leading psychiatrist, Dr. C. Macfie Campbell, of Harvard.

The first chapter, to judge by its title, was no doubt intended, and was certainly wanted, as a preliminary orientation and perspective as regards facts and terms. Evidently, through an act of courtesy and conformity with the organization of the association, the year's chairman of the Section of Medical Sciences was invited to offer this orientation, and he offered a brief introduction, in the form of "remarks . . . not entirely my own, because the phraseology as well as the ideas

¹ Publication of the American Association for the Advancement of Science, No. 9. Edited by Forest Ray Moulton and Paul O. Komora. 470 pp. Lancaster, Pa.: The Science Press. 1939. \$3.00.

have resulted from discussion with a number of people." He does not tell us who these co-responsible people are. Instead of offering a much-needed practical as well as theoretical orientation which would have had to bring together the "natural" and all the other (humanistic and formal linguistic-semantic and historical) sciences which belong in the American Association to be addressed, and which also deal with the topic of man and his health, the "remarks on the aims and purpose of the Symposium" hardly touch the content of the book, but merely reiterate the still widely prevailing old complaints of "isolation of psychiatry," which should cease being "an island lying off the mainland of medicine," and become part of the medicine he knows. In the place of a mere "inundation of words," still (?) obscured by such traditional abstractions as "mind and body," and the inveterate tendency to think that to be scientific one has to reduce specific sets of facts into "something else" before they are first made clear enough among themselves, psychiatry should yield "dry ground of observation, hypothesis and verifiable experiment" so as to connect the traditionally "isolated facts of mental function and mental disease with the more continental accumulations of physics, chemistry, physiology and pathology"—apparently questioning any necessary recognition of a specific status and role and methods of the mentally integrated data. "... the general tenets of science and the common rigors of scientific thought must be asked of the psychiatrist as well as of other clinicians." The advice that the topic should no longer be allowed to be treated "in an illogical or arbitrary manner" might have been reciprocal and properly addressed to both "the mainland" and "the island," when the introducer presented the praiseworthy injunction that we should from time to time re-examine the realities "with freshness, humility and understanding"—only to do glaringly otherwise. He does not seem to realize that in his simile of "mainland" and "island" it may be his "mainland of medicine" in general that is at least as responsible for the *mutual* "isolation" as the too often neglected "island" itself. If he does not see this, he gives a most deplorable example of blind-spot. Instead of bringing the "natural" and the "humanistic" sciences together into one common formulation of life and dynamics and motivation, with room for the settings also for the mentally integrated and differentiated parts or factors in the events, he speaks in terms of "psychological concomitants" and psychosomatics, harking back to parallelism. And while he urges the acceptance of the "patient that is," he leaves the real task in the hands of the "internist," experienced in nervous and mental disease and willing to consult also the psychiatrist. For his missionary spirit of exhortation he marks as his target the "timid incompetent physician" and "the bold incompetents" in the asylums. The best

he can do or cares to do with his exhortation is to select the internist instead of the "psychiatrist" as the basic and sole director of the field—leaving one wondering whether he confuses the psychiatrist, who certainly has to be a well-trained physician, with a psychoanalyst, who might indeed keep aloof but to-day is increasingly less inclined to do so. The reader looks in vain for an orientation of the present-day status of a science of man-function and of mental health or ill health with a real understanding of psychiatry and of psychology. What he finds quoted as samples is a caricature, and the warning that the terms are often "misused" to mean a "working knowledge of human nature," fits together with the cryptic characterization in the reference to the "hundreds of thousands of patients whose physical preservation only emphasizes their mental deterioration." With a fair and constructive discussion of the facts and the situation, a great gain in factual and logical orientation might have come to both "mainland" and "island," through a sound and much-needed working together of all that is pertinent and also free of the obsession that understanding should be a reduction of everything to something different from what it is, and more like one's own beloved continent.

Instead of a friendly inquiring visit to the territories treated as an island, or perhaps rather as an archipelago—seeking out the places of work closest to what his ideal reached for—he gives us a nightmare and a curtain lecture of largely non-pertinent reiterations of unfortunately still wide-spread complaints about mere inundations of words, impressions of private dialects and neologisms in a one sidedly dismal picture:

"Let us admit that state hospitals for mental diseases have harbored in service many a timid incompetent physician, but familiarity with bold incompetents elsewhere in the practice of medicine makes modesty rather more attractive than otherwise. To be just, however, we should recall that the field of psychiatry has also harbored physicians big enough to live their lives in frustration of their hope to find some way of easing the increasing load of mental disability or disease. It is such men who merit the interest, understanding, help and cooperation of the rest of the medical profession."

This is all very painful, and obviously largely quoted at a distance without any evidence of familiarity. Like so many specialists full of the universal dominance and ultimate explanatory power of the more and more about less and less, and missing their stand-bys of "gas exchange or water balance" in the attempts to relate such phenomena observed in the insane to known facts in other fields of medicine rather than other "personal terminologies," he wants to build out exclusively "from the mainland of medicine." Wherein does the speaker see not only the importance but the sense and nature

of psychology and psychiatry? He wants to bet on the salvation by the internist. He wants him to be "a highly trained internist, with interest and experience (where obtained?) in nervous and mental disease, not only permitted but urged, to elicit aid from as many sciences as appropriate: for example, physiology, chemistry, psychology, and psychiatry." Again I ask: Where obtained or found and cultivated, and how? The introducer displays a vicious circle of distrust derived from unfamiliarity and lack of curiosity as to what is actually being done—a sorry exhibition of the neighbors considering themselves the mainland. All he finally sees is that "it may be the great contribution of psychiatry in the future to describe and define the 'art' of medicine in more precise and useful terms by insisting upon the comprehension of the physician as one of the factors in the prevention and cure of disease." And what is the "comprehension"? What is to him the field and work of psychiatry and psychology if he does not allow it to aim for "a better working knowledge of human nature"? One might wish that one might at least and at last get closer to that; we might not have to run into the cryptic pessimism of this picture of the present "hospital beds filled to overflowing with hundreds of thousands of patients whose physical preservation only emphasizes their mental deterioration" and into "it is high time that the psychiatric problems such persons present be attacked in a fundamental manner with all our faculties for observation and facilities for investigation." He fails to say to what extent and how his internist will include and integrate the "mentally integrated facts" in his "internal medicine."

In the absence of a positive and real orientation on factual responsibilities and activities in the special field expected from the temporary chairman of Section N (Medical Sciences), the planned symposium begins abruptly with Chapter II, as "Orientation and Methods in Psychiatric Research" (pp. 9-66): Epidemiology, facilities for research in state hospitals, the structural and physico-chemical alterations of the central nervous system, convulsive disorders as a field of research, the field of clinical research on abnormal behavior in infancy, childhood delinquency, biometric methodology, the clinician's summary, the psychologist's view of fundamental and applied research, and the need of integrating the research forces of the country to secure support—each of these topics is treated by a competent special worker, and the group reviewed by prepared discussions and discussions from the floor.

The second session or section (Chapter III) deals with "Sources of Mental Diseases and Their Amelioration and Prevention" (pp. 71-145), but is limited to genetics, syphilis, alcohol, vitamins, fatigue, birth control, child caring, immigration—with noticeable omis-

sion of the "mentally integrated" or psychogenic dynamics and processes.

There follows "The Economic Aspects of Mental Health" (pp. 149-234): magnitude of the problem, economic loss, cost, family care, social security, the bearing of the emotional factors and economic disability and an especially replete review which contains much new material. The fourth session, on "Physical and Cultural Environment in Relation to the Conservation of Mental Health," deals with psychiatric and cultural pitfalls as seen by the anthropologist, and some comparative ethnological data on culture and personality, community differences, selective internal migration, segregated communities, integrative politics and communication of ideas (pp. 237-287)—actually contributions largely from non-medical collaborators, bringing in problems and view-points showing clearly the need of reciprocity between the specialized collateral disciplines of the science of man rather than what the worker in practical psychiatry comes to focus on. The next chapter, again from a very different angle, *viz.*, that of "Mental Health Administration," presents centralized state organization, state supervision of the feeble-minded, qualification of personnel, the practices dealing with admission to hospitals, psychiatric expert testimony, *bona-fide* residence and fiscal responsibility, meeting the needs of the patient during the first year of residence in a mental hospital, role of the mental hospital and provisions in a community, local health departments and statistics, the sociological aspect of mental health administration and the function of government (pp. 291-370). There follows as the last section an extensive detailed consideration of "Professional and Technical Education (of personnel) in Relation to Mental Health" (the specialists, undergraduate training, administrators, psychologists and specialists, nursing and the public health nurse, occupational therapy and social workers, relation to internal medicine, role of the clergy and choosing the medical student (437-454). Each of these items or topics is presented by a leading worker. The conclusion of the whole symposium consists, as stated above, in a public address to the whole congress, giving a comprehensive picture—from the life of a worker who has to face a very wide range of psychiatric problems and teaching and investigation—of "Human Needs and Social Resources," by C. Macfie Campbell (pp. 454-470).

It is an immense program of discussions of activity and organization, but relatively little about the specific and particular relation of the sciences among themselves and to the patient and his problems, and to the scientists and the public and the kind of facts to be met. One might have asked: To what extent are the American Association for the Advancement of Science as a group and the special medical section so oriented

as to meet man as a person for a basis of discussion of mental health? What is the status of science to meet this task? What do we mean by "mental" and how is it "worked"? What does the psychiatrically intelligent worker and public see in the field and in the concepts and methods? If it were not for the fact that there is much unnecessary but disturbing misconception concerning the problem, the "search" and the "research" might be much more effectively presented and pursued.

An attempt to characterize, and even more an attempt to summarize, the amount of material brought together in the forty-nine basic contributions and twenty-eight prepared and free discussions goes beyond the possibilities of a review. It is not so much any amazing amount of information that makes up the value of this symposium, nor largely the startling vision or glimpse into the monetary estimate of nearly a billion dollars loss in the United States of America per year through disorder of mental health, but it is rather the solid, descriptive and dependable factual material of the health problem that counts. A number of the basic papers, such as those on alcohol, child behavior and care, the summary of methods, the genetic discussion, and especially the economic studies, are quite outstanding; so are the discussions on administration and training of personnel and the relation among the specialties—never before brought together in such interrelation. The actual question of how one might get next to the crises and needs of the *patient* and the avenues of understanding and treatment and prevention—although perhaps not so clearly or specifically "public health and care issues," as public health is defined to-day—should nevertheless be vital also for any administration of the actual campaigns for progress. The division on "environment" is widening the horizon far beyond "public health" in the limited technical sense of the word; as such it proves probably more helpful to the studies in ethnology and population and sociological considerations than to those of the *strictly* medical sphere of modification of the costly results of the accumulation of invalids, and the studies of the elements and factors that contribute to the instability and unsettling of the equilibrium between the senseless and intemperate utilization of ever new implements and inventions, and on the other hand the lag of corresponding brain and character and intelligence development or even the simpler and more accessible possibility of making the public and the non-specialistic professions (including the rank and file of physicians) "psychiatrically and humanly more intelligent" and informed and the schools and universities more adequately attentive to the features of culture that should make for mental health and man's nature and self-regulation, and capacity to develop sound leadership.

The actual symposium appears to turn much more

on the management of the various functions around psychiatry than on the specific material and the concepts and methods of mental health—good, bad and indifferent—but at least open to a more positive sense and direction. What will give us the sense and respect for the cultivation of psychiatric intelligence and a cultivation and sharing and application of psychiatric experience?

The first group of presentations offered is not an orientation on common ground, but starts at once with research, perhaps too much with the glamor of desired progress rather than a substantial presentation of the actual work and the types of familiarity and preparedness required to meet the actual problems with a balanced division of labor and a well-grounded reaching out in the field of mental health. One comes to feel that "research" is too much discussed as a matter of mobilization of the time and money of special types of workers and privilege free of the responsibilities of the work with the necessities rather than as a basic organization of the actual search and work and spending, and a selection of workers from the ranks and consultants familiar with special needs and settings that will give validity to and respect for the real work and material, made fit also for the elaboration and promotion of opportunities for the solution of problems. This is too often expected from the hands of persons unfamiliar with the burdens of direct responsibility and routine, but largely longing for special privilege in the use of time and apparatus and investigative machinery and techniques oftener borrowed than invested by and from direct experience. Without a group of presentations of the actually prevailing "too much or too little" of divisions of labor and fields of operation, one gets an impression of "approaches from the outside" in the different chapters and an under-rating of the basic tasks and services actually practiced and the conditions to be met. Besides adventure we have to look to the cultivation of, and the rising from, the ranks and a correspondingly intelligent drawing in of the special talents and cultivation of tasks and centers and ramifications that bring up the centralization as well as decentralization, and intimacy as well as formal management and orientation of the work. Do theory and practice recruit themselves out of the actual work or out of more or less artificial implantations with a sound field also for hunches? We want basic training but not an uncritical spirit of introduction by one in no special way familiar with the problem and showing in himself the deliberate "continental" isolation of many leaders of medicine charging psychiatry with isolation. In the form taken by the chapter on the "Sources of Mental Disease and Their Amelioration and Prevention," one misses the core from which one might expect the warmth of contact and the bearing of all the qualities of the factors.

This holds also very largely for the fourth section in the quantification problem of statistics occupied largely with the demonstration of the immensity and distribution of the problem with too great a distance between the statistician and the worker furnishing his experience in fragmented data. The "physical" and "cultural" environment in relation to the conservation of mental health proves itself to have been treated almost exclusively by non-medical specialists—except in the discussion—with interesting perspectives but rather lacking in that immediacy of contact with the workers and the issues of the actual field of work dealing with our own particular civilization and organization. The existing desire for international and interracial and ethnological statistics does not go with commensurate similarity or consistency of workmanship. The mental health administration comes closer to the actual issues but is rather too separately towering over the workers; and the professional and technical education in relation to mental health deals more with new and often better divisions of labor than the conditions for better actual centers and better distribution of work and the personnel.

The upshot of the "symposium" might well be judged in the light of its contribution to "person-function" or *ergasia*, and the corresponding energizing and orientation on the part of the workers, producers and consumers, and the general picture of the living and working together of the concerns of this domain of "mental health." The best way to honor and use the volume of "Mental Health" will be that of frequent reference to the groups of papers pertaining to emergencies of practice and research; and the utilization also of the literature references. It would, however, mean a great deal to have an *index* of topics and workers and places worked in, perhaps in connection with a follow-up every three or five years giving the accessible summaries and perspectives and evaluations to many of the special statements.

When we make the public and the scientists mind-conscious, we also have to furnish better knowledge of where "mind-work" is found in specific forms in operation, open to constructive inquiry and participation—no doubt including a psychology and psychiatry based on a solid and comprehensive science of man as person and groups of persons, as well as of parts, in the successive phases of development and the origins and goals in settings in contact with life. Next would come the question of ways and means, and practical management and the organization of the workers and the work, and a knowledge of where to go to find the information and help actually at work in demonstrative samples of performance.

What strikes me in so many of the discussions is the strange or foreign remoteness of the considerations

from where and in whom and wherein the actual problems take place. Where and when do the things happen that call for attention? Where does one go to meet the facts as they are? Because of the lack of an introduction written by a competent psychiatrist instead of a rehearser of anachronistic tradition, one has a feeling as if most of the matters discussed were mainly concerns of the administrator, the investigator and experimenter and as if the patient were largely "the victim" and a kind of host of the trouble, and not a *participant* and center of the difficulty itself and the live entity to be guided as well as helped and searched and researched and sampled and regulated—expected finally to regulate itself. This is where the concepts of what is called psychology and person-function show their fullest colors and specific modes of dynamics on which the amelioration and prevention in the end turn and depend and where the *ergasiologist* has to prove himself as not merely a good internist and sociologist, but really an expert in biotechnics and in biography in the making and in action. This is where the introducer would probably point his finger at special "words," forgetting that they are essentially signs pointing to one's having to turn to the facts and, even further, to what they stand for. It is perfectly true that we must expect of the psychiatrist sound medical training along all the specifically medicinal lines, but with just as much of a sound grasp on the "person and setting," situational and personal, psychological, physiological and sociological and biographic. For a great deal of "person-function" (*i.e.*, psychology as psychobiology, or, more modestly and objectively, "ergasiology," mentally integrated functioning, occupied with the working rather than with the substantialized soul or with mere physiology) the experience and use of sound critical common-sense counts for more than either the chemical or genetic or physiological detail or detachable exogenic factors such as alcohol and spirochaetes, or metabolism.

One has a right to say that any one not able to include in the physician's work and responsibility what one can learn from novels and life records should not be a physician,² but also that any one devoid of physiological and anatomical "at-homeness" should not pose as one with a well-rounded general education, or as a safe sample of general leadership.

The evolution of a disorder may have its soil in heredity and its immediate difficulties in the "daily" diet or regular régime in care of self, and the functioning and involvements of personality life. That is what the *ergasiologist* has to learn to command as his special concern: the description and singling out

² See the conclusions from the "Symposium on Materials and Methods of Human Nature and Culture," *Am. Jour. Psychiatry*, 92: 355, 1935.

of specific findings and their correction and operation. But of all of it, relatively little is said and sought. We have our own specific concepts for the aggregate of events, and "psychology" includes the science of the way in which the functioning also deals with itself, as our mentation with its wealth of sign-function that works not only as a tool, but rises from our dialects or intimate and local means of interchange to our more widely comprehensive and intelligible conceptions in which we can transact our business and finally evolve the very science and critical thought and planning on which our conduct of life feeds and prospers. This part is essentially that of the representation of the sharable preparedness to muster what as individuals and groups we include in our nature in behalf of the regulations of "history in statu nascendi," the shaping of human fate.

To do justice to the remarkable assemblage of the free expression of sixty-eight contributors would mean a huge task and deserve something more like a book than a review, but even better, a succession of reviews or symposia on the symposium.

The problem is of such vital and far-reaching importance that the American Association for the Ad-

vancement of Science would render a real service by appointing for a time a representative committee that would give a follow-up report from time to time aiming at digestion and the further development of appetite and orientation in the field: a committee on man's health as person and group—with a promotion of a psychology and a psychiatry and their foundations and bearings worth cultivating and consulting in behalf of the health of man and his civilization, not only as techniques and means of formal management but also its intrinsic logic and meaning. Out of that may arise a more widely permeating understanding of the interrelations in behalf of man of the sciences which the association brings together in its annual meetings. It would cultivate opportunities for the collateral sciences to help in the orientation among the actual workers rather than reiterations of the old prejudices used for false and ineffective self-excuse and perpetuation of reciprocal isolation.

The symposium deserves wide-spread attention and our gratitude to the organizers and contributors, and perhaps fully as much to those who challenge critical thought, as to those who give us the already available perspectives and the positive lifts and techniques.

OBITUARY

HANS ZINSSER

Bacteriologist, teacher, philosopher, author, poet,
soldier

November 17, 1878—September 4, 1940

He who is plentifully provided for from within needs but little from without.—*Goethe*.

HANS ZINSSER, Charles Wilder professor of bacteriology and immunology at the Harvard Medical School, died of lymphatic leukemia on September 4, 1940, at the Memorial Hospital for the Treatment of Cancer and Allied Diseases in New York City, where he had been a patient for the previous two weeks. During the summer he continued at work in his laboratories at the Harvard Medical School up to August 16, about the time of his departure for the hospital in New York.

By his death, the medical profession has lost one of its most brilliant and versatile personalities. It is difficult in a brief obituary notice fully to analyze and estimate his accomplishments, as he achieved success in many fields. He was internationally recognized as one of the most distinguished bacteriologists and scientific investigators of his age; he was acknowledged as an authority on medical education; he was an inspiring and dynamic teacher; he was generally conceded a leader in preventive medicine and in the direction of medical research. As an author, his great literary ability and originality have been universally recognized, and his last work, his autobiography, was selected as the "Book of the Month" for July.

Dr. Zinsser was born in New York on November 17, 1878, the son of August and Marie Theresia (Schmidt) Zinsser. In June, 1905, he married Ruby Handforth Kunz of New York. He is survived by his widow, a son and a daughter. The son, Hans H. Zinsser, is a second-year student at the Harvard Medical School and was married in June of this year to Anne Drinker, daughter of Dean Cecil Kent Drinker, of the Harvard School of Public Health. His daughter is the wife of Vernon Munroe, Jr., of New York City.

Dr. Zinsser was graduated from Columbia University with the degree of A.B. in 1899. He received the degree of M.A. from this university the same year that he received his M.D. from the College of Physicians and Surgeons (Columbia). After an internship at Roosevelt Hospital, N. Y. (1903–1905), he held bacteriological positions in New York at the Roosevelt Hospital (1905–1906); assistant pathologist, St. Luke's Hospital (1909–1910); and Columbia University (1905–1906, 1908–1910). In 1910 he went to California to become professor of bacteriology at Leland Stanford University, returning to Columbia in 1913 as professor of bacteriology and immunology, until 1923. He became professor of bacteriology and immunology at Harvard Medical School, Boston, in 1923, and Charles Wilder professor of bacteriology and immunology in 1935.

He received the honorary degree of doctor of science from Columbia University in 1929, Western Reserve

University in 1931, Lehigh in 1933, Harvard in 1939 and Yale in 1939. In conferring the honorary degree at Harvard, President Conant said of him: "A dynamic teacher whose vision extends beyond his laboratory; a famed investigator of the secret ways of man's microscopical enemies." At Yale, Professor William Lyon Phelps, conferring the degree, said in the course of his remarks: "He is one of the foremost laboratory scientists, and in the midst of his war against disease he has made friends everywhere in the world; his chronic courage is salted with humor; for although he is a medical philosopher, we may say of him what Edwards said to Johnson, 'cheerfulness is always breaking in.'"

He was a member of the American Red Cross Sanitary Commission to Serbia in 1915, and during the World War he served as Major and later as Colonel of the Medical Corps of the A.E.F., 1917-19. In 1923 he went to Russia as a sanitary commissioner for the Health Section of the League of Nations. In 1935 he was an exchange professor to France. He was awarded the Distinguished Service Medal of the United States, the Chevalier of the French Legion of Honor and the Serbian Order of St. Sava.

At the time of his death, in addition to holding the position of professor of bacteriology and immunology at Harvard, he was chief of the bacteriological services of the Children's and Infants' Hospital, consultant in bacteriology at the Peter Bent Brigham Hospital, and a trustee of the Massachusetts General Hospital.

He was a member of some 36 scientific societies, including the Association of American Physicians, American Academy of Arts and Sciences, National Academy of Sciences, American Academy of Tropical Medicine, American Association for Advancement of Science and the American Association of Immunologists (president, 1919).

In 1915 a great change came into his life, which obviously markedly influenced the later years of his work. As he himself wrote: "I felt I ought to get into the war in some capacity, and my chance came in March, when" there was "organized the Red Cross Typhus Commission for Serbia." Writing of his experiences at that time in regard to the Serbian epidemic, his "first experience of mass misery," while he refers to it as "as terrifying and tragic an episode as has occurred since the Middle Ages," his reminiscences of it (he says) are on the whole rather prosaic. Afterwards his great interest in the disease continued until the end. One sees this in the time and energy he devoted to his book, "Rats, Lice and History," which has been referred to as "the biography of a disease" and as a popular history of typhus. In the closing chapter of that book, he writes: "Not every one realizes that typhus has at least as just a reason to claim that it 'won the war' as any of the contending nations." It was well known to us in Serbia

in 1915 from various sources that the Austrian and German armies were only waiting the subsidence of the typhus epidemic before crossing the Danube and invading the country, for the Allies had done nothing to reinforce the Serbian troops and prevent such an invasion of their country. In regard to this situation, Dr. Zinsser wrote:

During all this time Serbia was practically helpless. Yet Austria did not attack. Austrian strategists knew better than to enter Serbia at this time. The probable results were obvious. Typhus—while scourging the Serbian population—was holding the border. The Central Powers lost six months during the most critical time of the war. It is anybody's guess as to the effect which this delay may have had on the early Russian and even on the Western campaigns. It is at least not unreasonable to believe that a quick thrust through Serbia at this time—with its reactions on Turkey, Bulgaria and Greece—the closing of Salonika, and the establishment of a South-western front against Russia might have tipped the balance in favor of the then very vigorous Central Powers. Typhus may not have won the war—but it certainly helped.

Dr. Zinsser's travels and studies, not only in Serbia but in Russia, Mexico and China, also especially enhanced his interest in the typhus group of fevers.

During the past ten years he had especially devoted his attention, and directed that of a number of his associates, to the problems of animal reservoirs, methods of transmission and immunization of the diseases of the typhus group, and has made some thirty-three original contributions, generally with his associates (especially Castenada) upon these subjects. As early as 1930, with some of his associates, he demonstrated that an active immunization against the murine or European varieties of typhus fever could be produced in animals with formalinized suspensions of the respective micro-organisms. In a paper published with Plotz and Enders in *SCIENCE* (January 12, 1940), which should be read in detail, various steps in the progress made by different investigators employing different methods for the mass production of typhus vaccine of the European type are outlined. The method finally recommended for securing large numbers of *Rickettsiae* consists of a combination of the agar tissue procedure of Zinsser, Wei and Fitzpatrick (1937), and of Cox (1938) of yolk sac culture, somewhat modified and employed as a source of inoculum.

At the time of publication of this last article, a number of daily newspapers wrote lengthy articles emphasizing the importance of the discovery. Dr. Zinsser, however, in an interview the following day, modestly deplored the publicity attendant upon the work, saying that it was merely a short step forward, based on the long and patient efforts of many people in different parts of the world.

His exceptional scientific attainments as an author

have been well known to the medical profession for many years, not only by his individual contributions to journals, upon bacteriological research and the study of infectious diseases, but especially by his text-books. He has been a prolific writer of scientific articles since 1903, having contributed some 176 papers in the current journals. His "Text Book of Bacteriology," first published in 1910 and now in its eighth edition¹ presents in a clear and concise manner the fundamentals of bacteriology and immunology and the application of this knowledge to the understanding and control of infectious diseases; in addition, emphasizing the conception of medicine as a division of biological and social sciences in relation to other sciences. I do not know of a better text-book written on the subject, and it has proved almost indispensable, especially to physicians and students of bacteriology and preventive medicine.

His "Resistance to Infectious Disease" was published first in 1914 and was affectionately dedicated to his father, "A.Z." A second edition appeared in 1918, and a third in 1923. A third text-book, rewritten and now in its fifth edition under the title of "Immunity: Principles and Application in Medicine and Public Health"² constitutes a practical treatise upon the biological phenomena of infection and recovery of the animal body from infectious disease, with the consideration of the application of the principles of immunity to diagnosis, treatment and prophylaxis and their usefulness in the control of epidemics. This text-book has also proved of inestimable value to medical students, laboratory workers and students of public health.

Although his life has been an unusually busy one in active research and the direction of the work of others in his laboratory, as well as in teaching, the fact that these two text-books have been kept very fully up to date is another evidence of his great vitality, energy and capacity for hard work.

Dr. Zinsser was one of the principal participants in the symposium held at the Harvard Medical School of public Health on "Virus and Rickettsial Diseases" in June, 1939, and wrote not only the introduction to this volume, published in 1940, but also the two chapters on "The Immunology of Infections of Filtrable and Virus Agents" and "Epidemiology and Immunity in the Rickettsial Diseases."

Recently he had attained spectacular success as a writer in the authorship of two "best sellers"—"Rats, Lice and History" (1905) and his autobiography, "As I Remember Him; The Biography of RS," published during the present year.

This last book has been referred to as the conscious

obituary of a man who knew he had but a comparatively short time to live, and in it he has described in the third person the pleasure and satisfaction he gained from various incidents as he approached death. He had been writing this book intermittently for some years, but had intensified his efforts since his return from China in June, 1938, when he and his physician recognized definite symptoms of lymphatic leukemia. However, instead of retiring to a life of leisure and rest, he continued his work in his laboratories and upon this book, with at times even more than his usual vigor. On occasions when stricken with weakness it was necessary for him to spend several days in a hospital and undergo x-ray treatment for the disease that was daily sapping his strength. After such treatment, when he had recovered somewhat from the shock of the treatment, the condition of his blood frequently became temporarily improved and he would return to his laboratory work. Such a life he led with full knowledge that he had only a comparatively short time to live. Courageously he continued to work and write, although anticipating his death. Only a few months ago, when a number of the chapters of his last book had appeared in the *Atlantic Monthly*, he spoke of these facts and then at the same time of the satisfaction he was still having in writing it. Such quiet, steadfast courage as he displayed in his daily life cannot be surpassed or forgotten. For, as he himself wrote of Francis Weld Peabody, "Courage is still, as it always has been, a thing of great beauty that springs, whatever its form of expression, from an inner source of moral power."

During the past summer, he drove his automobile from his home to his laboratories at the Harvard Medical School each day, pursuing his work, and in the evenings and on certain holidays saw his friends and lived the life of a man keenly interested in everyday affairs. When he went to New York to undergo another form of treatment a few weeks ago, while referring to it in a way as a vacation, he intimated to a very few that the treatment might be experimental and that he might not be able to return.

One of the earliest ambitions of Dr. Zinsser was apparently in the direction of literature. He has been a writer of verse for years, and during the past fifteen years has contributed twenty-four poems and sonnets to the *Atlantic Monthly*. His last sonnet from that magazine, published in 1940, reveals a depth and sweetness and tenderness that, alas, few of us had realized him to possess, and in it there is evidence of a mastery of form and feeling that marked him truly as a poet of great ability.

Morris Fishbein, editor of the *Journal* of the American Medical Association, in referring to "As I Remember Him," writes: "It is a medical biography to take its stand as a classic beside the Vallery-Radot 'Life of Pasteur,' the Paget 'Sir Victor Horsley' and

¹ "Text Book of Bacteriology," by Hans Zinsser and Stanhope Bayne-Jones, Appleton-Century Company, 1939.

² By Zinsser, Enders and Fothergill, Macmillan Company, 1939.

indeed even the Cushing "Life of Sir William Osler." It is as fine a contribution to autobiographic writing as I have known.

Dr. Robert M. Green, associate professor of anatomy at Harvard, also writing of this book, asks: "Can any man be wholly known to his contemporaries? Oliver Wendell Holmes, autoerast, anatomist, and poet, wrote that each of us has at least three personalities: one as he is known to his maker, one as he is known to his fellow men, and one as he is known to himself. It is this third intrinsic personality of RS which Dr. Zinsser from long acquaintance and intimate documents has revealed. Out of an alembic mixture of recollection, personal confession and observation, he has recreated for us the real self of a man whom we have long admired and loved, but not fully appreciated."

Many of us are sensible of and in accord with this statement, and those of us who have been acquainted with Dr. Zinsser during the past few years recognize from his last writings not only elements of his character that we knew, but in addition other traits apparent, the existence of which we had not even realized or appreciated. For as he once wrote, as Carlyle says of Schiller, "the man's heart which few knew was as true and noble as his genius which all knew."

Dr. Zinsser, in his last chapter, in which the end of the life of RS is described, relates that during the last months his philosophy ripened and that he achieved a certain degree of philosophical tranquility, revealing something of the sweetness and the light of love in his soul. Although moving further away from faith in any comprehensible conception of God, yet he grew closer to the conviction of the wisdom and guiding

integrity of the compassionate philosophy of Christ. He "felt increasingly grateful for the fact that death was coming to him with due warning, and gradually. So many times in his active life he had been near sudden death by accident, violence or acute disease; and always he had thought that rapid and unexpected extinction would be most merciful. But now he was thankful that he had time to compose his spirit and to spend a last year in affectionate and actually merry association with those dear to him. He set down this feeling in his last sonnet:

Now is death merciful. He calls me hence
Gently, with friendly soothing of my fears
Of ugly age and feeble impotence
And cruel disintegration of slow years.
Nor does he leap upon me unawares
Like some wild beast that hungers for its prey,
But gives me kindly warning to prepare:
Before I go, to kiss your tears away.
How sweet the summer! And the autumn shone
Late warmth within our hearts as in the sky,
Ripening rich harvest that our love had sown
How good that 'ere the winter comes, I die!
Then, ageless, in your heart I'll come to rest
Serene and proud, as when you loved me best.³

Dr. Zinsser lived a very full and unusually active life almost to the moment of his death, and the influence of his example and career will long continue. His deep faith in the power of honest scientific work to promote human welfare will long be a guiding light to others. His spirit will benefit humanity for many years to come, and no one who ever knew him will forget him.

RICHARD P. STRONG

SCIENTIFIC EVENTS

POLLUTION INVESTIGATIONS OF THE FISHERIES SERVICE

ACCORDING to *The Fisheries Service Bulletin*, Dr. M. M. Ellis, in charge of the service's pollution investigations in relation to aquatic life, reports that the field surveys carried out this summer have resulted in the collection of more material and more data than any previous trip. This success is attributed by Dr. Ellis, in part, to the use of new analytical methods and new physiological apparatus in the laboratory trucks from which the surveys were made.

During part of the month of July Dr. Ellis and his party visited the Black Hills region of South Dakota, where they cooperated with state officials in a study of gold-mine wastes in relation to stream conditions and fish life. A second problem investigated at the request of the state was the extent to which beaver dams modify stream conditions and water characteristics. Dr. Ellis reports that the beaver-dam problem

in South Dakota appears to differ considerably from the situation in Michigan and other localities where these dams have been studied previously.

After collecting material related to the study of arsenic pollution at Gardiner, Mont., the field party proceeded to central Idaho for a study of irrigation waters from the Snake River, and thence to the Salmon River Valley to continue the studies of salmon spawning streams begun in previous years. Using Red Fish Lake in the Sawtooth Mountains as a base, the investigators were successful in securing much new data on these salmon spawning waters and also on waters frequented by the so-called redfish.

Mine-waste problems in the Coeur d'Alene region of Idaho engaged the attention of the field party for approximately ten days, after which it proceeded to Rock Island Dam on the Columbia River. Dr. Ellis has been following the changes in the water of the

³ Quotation by permission of the *Atlantic Monthly*.

Columbia and tributary streams since before the construction of the Grand Coulee Dam. These observations were greatly extended this summer, and in addition extensive physiological studies were made of the salmon and other fish passing through the Rock Island traps.

During the latter part of August studies were conducted of glacial waters near Mount Ranier and Mount Shasta, investigations which are closely related to the Sacramento River project and its effect on aquatic life.

THE MEDICOFILM SERVICE OF THE ARMY MEDICAL LIBRARY

ACCORDING to a statement by the librarian of the Medical Corps of the U. S. Army, Colonel Harold W. Jones, under the authority of the Surgeon General of the Army, microfilm copying from the medical collections of the Army Medical Library has been conducted for nearly three years by Biblionfilm Service, a non-profit agency having its headquarters in the library of the U. S. Department of Agriculture. Although this service has rendered valuable aid to many research workers, it is believed that a microfilm copying service operating within the Library itself, and specializing in the field of medicine, will be able to contribute even more to the advancement of medical science.

The new service has been established through the generosity of a group of "Friends of the Army Medical Library." It has been given the designation "Medicofilm Service."

The service described will be conducted on a non-profit basis solely for making the extensive medical literature collections of the Army Medical Library available to research workers who are unable to come in person to consult them. The library cooperates by providing the necessary space for the work and by supplying the publications from which the microfilm copies are made. The only cost to the user is for the actual labor and materials required in making and distributing the microfilm copies.

The photographic copies on moving picture film of the separate articles in the periodicals are made at 30 cents for each complete article not exceeding 30 pages in length and 10 cents for each succeeding 10 pages or fraction thereof. A pamphlet describing the service and also containing the latest list of the approximately 4,000 medical and related periodicals currently received by this Library will be sent to those desiring to avail themselves of this service. In addition to medical periodicals the library also possesses an extensive collection of manuscripts and incunabula of which microfilm copies may be obtained. Requests should be made to: Microfilm Service, Army Medical

Library, 7th St. and Independence Ave., S.W., Washington, D. C.

THE SEALING OF THE TIME CAPSULE

CEREMONIES incident to the final sealing of the Time Capsule of the exhibit of the Westinghouse Electric and Manufacturing Company at the New York World's Fair took place at noon on September 23. The capsule was deposited in the ground outside the exhibit building before the fair was opened on September 23, 1938.

Harvey D. Gibson, chairman of the World's Fair of 1940, welcomed the gathering, and A. P. Craig, Westinghouse Exhibit director, presided. Dr. Clark Wissler, anthropologist of the American Museum of Natural History, and David S. Youngholm, vice-president of the Westinghouse Electric and Manufacturing Company, took part in the sealing of the capsule. Dr. Albert F. Blakeslee, president of the American Association for the Advancement of Science, made an address at a program "Youth Looks toward the Future," held in the afternoon under the auspices of the American Institute of the City of New York.

During the sealing-in ceremonies, 500 pounds of a special mixture of pitch, chlorinated diphenyl and mineral oil was poured around the capsule. This compound, because it resists electrolysis and is impervious to moisture, will provide a first line of defense against the destructive effects of time. It was developed by J. G. Ford as a seal for condenser bushings in circuit breakers.

The compound remains plastic over a 225 degree Fahrenheit temperature range, from 40 degrees below zero to 185 degrees above. This means that it will not crack open to enable the start of electrolysis. Its dielectric strength enables it to resist an electrical discharge up to 40,000 volts. It is one and one fifteenth times as dense as water, so that moisture can not penetrate to start corrosive action. It will adhere tightly to the metal for many hundreds of years through a wider variation in temperatures than that to which the capsule will be subjected. The capsule itself is made of cupaloy. This is an alloy of 99.4 per cent. copper, .5 per cent. chromium and .1 per cent. silver which can be hardened to the temper of mild steel but retains resistance to corrosion equal to pure copper.

David S. Youngholm, vice-president of the company, made a statement in which he said that more than forty articles used every day by people of the present are packed in the capsule.

Among them are a fountain pen and mechanical pencil, a watch, an electric lamp, a tobacco pouch with zipper, tobacco, pipe, cigarettes, cosmetics, a woman's hat, eyeglasses, toothbrush and powder, a miniature camera and

film, a razor, a can opener, specimens of our money and so on.

In addition there are samples of the major metals and alloys; textiles, including wool, cotton, silk, linen, rayon, glass fabrics, rubber fabrics, asbestos cloth; materials such as Portland cement, asbestos, synthetic and natural rubber, synthetic plastics; also samples of coal (which may be rare in 5,000 years), seeds of staple food crops, and many other items.

Possibly the most important item packed in the Time Capsule is a carefully prepared microfilm "essay" on our times, taken from books, almanacs, pictures, catalogues, etc., and arranged in logical order to cover all the major activities of human life.

Multi-lingual texts, a dictionary and an idiomatic lexicon will enable future historians readily to translate the texts of the microfilm. All film in the capsule is acetate, specially prepared for permanence. The microfilm essay contains more than 23,000 ordinary book pages, reproducing more than 10,000,000 words, and many hundreds of pictures. A microscope is enclosed to enable "futurians" to read the text. Complete directions in text and picture are given for the construction of a larger reading machine and a motion picture projection machine. For use in this machine is a newsreel enclosed, especially prepared for the people of A.D. 6939, containing nearly a score of historic, typical, or significant scenes of our day with sound.

SCIENTIFIC LECTURES OF THE COLLEGE OF PHYSICIANS OF PHILADELPHIA

THE program for 1940-1941 of evening scientific lectures of the College of Physicians of Philadelphia is as follows. In all cases the lectures will open at 8:30 P.M.

September 25. Nathan Lewis Hatfield Lecture XXIV, George W. Corner, director of the department of embryology, the Carnegie Institution, Baltimore. "The Physiological Basis of Corpus Luteum Therapy."

November 6. S. Weir Mitchell Oration VIII, John F. Fulton, Sterling professor of physiology, Yale University. "Neurology and War."

December 4. Thomas Dent Mütter Lecture LIII, Allen O. Whipple, professor of surgery, College of Physicians and Surgeons, Columbia University. "Recent Studies in the Circulation of the Portal Bed of the Spleen in Relation to Splenomegaly."

January 8. James M. Anders Lecture XVI, Thomas Francis, Jr., New York University. "The Problem of Epidemic Influenza."

February 5. Mary Scott Newbold Lecture XLVIII, Thomas T. Mackie, assistant clinical professor of medicine, College of Physicians and Surgeons, Columbia University; attending physician, the Roosevelt Hospital. "Studies in Ulcerative Colitis."

March 5. Alvarenga Prize Lecture, Ernest W. Goodpasture, professor of pathology, Vanderbilt University. "The Cell-Parasite Relationship in Bacterial and Virus Diseases."

April 2. Nathan Lewis Hatfield Lecture XXV, George L. Streeter, Carnegie Embryological Laboratory, the Johns Hopkins University, Baltimore. "New Data on Embryogenesis in Monkey and Man" (illustrated).

May 7. James M. Anders Lecture XVII, Henry F. Vaughan, commissioner of health, Detroit, Michigan. "The Way of Public Health."

LECTURES FOR THE GENERAL PUBLIC

November 15. Chevalier Jackson, honorary professor of broncho-esophagology, Temple University School of Medicine. "The Bronchoscope." (Lantern and motion picture demonstration of the instrument, its uses and what it has contributed to medical science and public welfare.)

January 24. Hubley R. Owen, director of public health, Philadelphia. "Activities of the Department of Public Health, with Plans for the Future."

April 18. Richard A. Kern, professor of clinical medicine, University of Pennsylvania Medical School. "Allergy and You."

THE AMERICAN ORNITHOLOGICAL UNION

THE fifty-eighth annual meeting of the American Ornithological Union was held at the New England Museum of Natural History in Boston and at the Institute of Geographical Exploration at Harvard University from September 9 to 15 with a registered attendance of three hundred and ten. Thirty-nine scientific papers were read—many illustrated by color slides or films. The three days of program sessions included a like number of evening entertainments, open house at the New England Museum, the annual dinner and business meetings of various sections. On Friday ornithologists in attendance took a field trip to favorable localities along the coast north of Boston. On Saturday and Sunday many visitors traveled to Chatham and Cape Cod, with a beach wagon trip to Monomoy Point to observe pelagic birds.

Officers elected for the new year were: *President*, Dr. James P. Chapin, New York City; *Vice-presidents*, George Willett, Los Angeles, and Dr. J. L. Peters, Cambridge; *Secretary*, Dr. Lawrence E. Hicks, Columbus; *Treasurer*, Rudyard Boulton, Chicago; *Council*, James Savage, Buffalo, Dr. Josselyn Van Tyne, Ann Arbor, and Dr. Ira N. Gabrielson, Washington, D. C.

The Brewster Medal was awarded to Dr. James L. Peters, of Cambridge, for his four volumes published to date on "The Birds of the World." Two fellows—Stanley G. Jewett, Portland, Ore., and Robert T. Moore, Pasadena, Calif., and one corresponding fellow, Dr. Oliveirio Pinto, of Brazil, were elected.

In addition to 228 new associate members, eight new members were named: Oliver L. Austin, Tuckahoe, N. Y.; Joseph J. Hickey, New York City; George H.

Lowry, Baton Rouge, La.; Eugene E. Murphey, Augusta, Ga.; John R. Pemberton, Altadena, Calif.; Arlie W. Schorger, Madison, Wis.; Milton B. Trautman, Put-in-Bay, Ohio, and Lawrence H. Walkinshaw, Battle Creek, Mich.

The meeting in 1941 will be held in Denver in September.

THE AMERICAN MATHEMATICAL SOCIETY

At the joint meeting of the American Mathematical Society and the Mathematical Association of America held at Dartmouth College, Hanover, N. H., from September 9 to 12, the following resolutions were adopted, upon the recommendation of the War Preparedness Committee, Professor Marston Morse, of the Institute for Advanced Study, *chairman*:

1. That all competent students in the secondary schools take the maximum amount of mathematics available in their institutions. In the case of many schools additions to the present curriculum will be necessary in order to furnish an adequate background for the military needs of the country.

2. That the colleges and universities at once make such revisions of their undergraduate courses in mathematics and add such courses to the curriculum as are necessary to prepare students in the elements of mechanics, probability, surveying, navigation and other essentials of military science.

3. That the graduate schools extend their courses in

applied mathematics, such as dynamics, hydrodynamics, elasticity, aeronautics, ballistics, statistics, etc., and that advanced students be urged to become highly qualified in one or more fields of applied mathematics.

This is a first step in the fulfillment by this committee of its dual mission of education and research.

Sub-committees were constituted with chairmen as follows:

Research—Professor Dunham Jackson, University of Minnesota.

Preparation for Research—Professor M. H. Stone, Harvard University.

Education for Service—Professor W. L. Hart, University of Minnesota.

To aid in research, chief consultants were named in the following fields:

Ballistics—Professor John von Neumann, Institute for Advanced Study.

Aeronautics—Professor Harry Bateman, the California Institute of Technology.

Mechanical and Electrical Aids to Computation—Professor Norbert Wiener, the Massachusetts Institute of Technology.

Industry—Dr. T. C. Fry, Bell Telephone Laboratories.

Cryptanalysis—Professor H. T. Engstrom, Yale University.

Probability and Statistics—Professor S. S. Wilks, Princeton University.

SCIENTIFIC NOTES AND NEWS

THE autumn meeting of the National Academy of Sciences will be held at the University of Pennsylvania on October 28, 29 and 30.

THE autumn general meeting of the American Philosophical Society will be held on November 22 and 23, beginning at 10 A.M., on Friday. On that day recipients of grants from the research funds will present reports of the progress or completion of their projects. On Friday evening there will be a public lecture followed by a reception.

DR. JOHN VAN NOSTRAND DORR, consulting metallurgist, president of the Dorr Company, Inc., New York City, has been awarded the Perkin Medal of the Society of Chemical Industry for 1941. Presentation of the medal will be made at a meeting to be held by the society on January 10 at the Chemists' Club, New York.

DR. JOHN R. MOHLER, chief of the Bureau of Animal Industry, U. S. Department of Agriculture, Washington, has been chosen Kober lecturer for 1941 under the rules governing an endowment fund established by the late Dr. George M. Kober. Dr. Mohler will deliver the lecture on March 28. He will speak

on "Undulant Fever," under the auspices of Georgetown University.

CLOYD M. CHAPMAN was awarded honorary membership in the American Society for Testing Materials at its forty-third annual meeting "in recognition of his work in developing a system of medical x-ray photography, which makes it possible to examine a large number of individuals a day at a very moderate cost."

DR. GERALD WENDT, retiring director of Science and Education at the New York World's Fair, was the guest of honor at a party given at the Television Theater of the RCA Building at the fair on September 25, at 5 P.M. The event was arranged "in recognition of Dr. Wendt's services during his three-year connection with the fair and to present a preview of a collection of three-dimensional pictures recently taken by him of well-known scientific men at work on current research projects in their laboratories."

THE *Journal* of the American Medical Association reports that the Monroe County, Indiana, Medical Society recently held a dinner meeting in honor of

Dr. Burton D. Myers to mark his retirement as dean of the Indiana University School of Medicine at Bloomington. Dr. Myers had been dean of the school since 1927. He joined the faculty in 1903 as professor of anatomy, becoming assistant dean in 1920. He retired on July 1 having reached the retirement age of seventy years. At the dinner Dr. Myers was presented with life membership in the Monroe County Medical Society. The speakers included Dr. Karl R. Ruddell, Indianapolis, president of the State Medical Association; Dr. Herman B. Wells, president of Indiana University; Dr. William Lowe Bryan, president emeritus of Indiana University; Attorney George Henley, and Thomas A. Hendricks, executive secretary of the State Medical Association.

DR. THOMAS BYRD MAGATH, of the Mayo Clinic, Rochester, Minn., was elected vice-president of the Minnesota State Board of Health at a meeting held on August 29 in Minneapolis.

DR. WESLEY C. GEORGE, professor of histology and embryology at the School of Medicine of the University of North Carolina, has succeeded the late Dr. Charles S. Mangum as head of the department of anatomy.

THOMAS B. DREW, supervisor in the engineering department of E. I. du Pont de Nemours and Company, Wilmington, Del., has been appointed associate professor of chemical engineering at Columbia University.

DR. CYRUS C. MACDUFFEE, professor of mathematics at the University of Wisconsin, has been appointed professor at Hunter College, New York City. He will fill the vacancy left by the retirement of Dr. Lao Genevra Simons, chairman of the department.

At the Michigan College of Mining and Technology Dr. Henry L. Coles, head of the department of chemistry and metallurgy at the University of Alabama, will take the place of Dr. C. M. Carson, who retires as head of the department of chemistry and chemical engineering after serving for more than twenty-five years. Dr. Ralph E. Menzel, head of the department of chemistry of Phillips University, Enid, Okla., has been appointed an assistant professor.

ADDITIONS to the faculty of Cornell University, some of which have been already announced, are as follows: *Chemistry*, Professor Peter Debye, as chairman of the department; *Physics*, Bruno Rossi, associate professor; *Psychology*, Richard Parmenter, assistant professor; *Engineering*, Ebon H. Carruthers, assistant professor of metal processing; *Agriculture*, Karl C. Hamner, assistant professor of plant physiology, in charge of plant investigations in the U. S. Plant, Soil and Nutrition Laboratory at Cornell, Gordon H. Ellis, assistant professor of biochemistry and nutrition and

biochemist in the Federal laboratory, Robert B. Musgrave, assistant professor of field crops and assistant agronomist, field station.

IN addition to the appointment, recently announced in *SCIENCE*, of Dr. Otto Loewi, as research professor of pharmacology in the College of Medicine of New York University, Dr. Daniel Bartholomew Kirby, visiting surgeon in charge of ophthalmological service at Bellevue Hospital, has been appointed professor of ophthalmology.

DR. LEWIS C. SCHEFFEY, clinical professor of gynecology at the Jefferson Medical College of Philadelphia, has been elected professor of gynecology to succeed Dr. Brooke M. Anspach, who retired recently with the title professor emeritus. Dr. Anspach had held the chair of gynecology since 1921 and had been a member of the faculty since 1917.

DR. FREDERICK R. WHITTLESEY, associate professor of medicine at the School of Medicine, at Morgantown, of the West Virginia University, has been appointed director of the dispensary and coordinator of clinics at the College of Medicine, at Omaha, of the University of Nebraska.

DR. PHILIP L. HARRIS resigned from the faculty of the Medical College of South Carolina on September 1. He is now in charge of the Biological Laboratory of Distillation Products, Inc., Rochester, N. Y.

CHARLES R. MCLENDON, formerly city editor of the *New York Herald Tribune*, and also a member of staffs of *The Sun* and the *World-Telegram*, has been made editor of *Popular Science Monthly*.

DR. HELEN S. MITCHELL, research professor of nutrition at the Massachusetts State College, has been requested to act as nutrition consultant with the Council for National Defense. She will work with Dr. Hazel Steibeling, senior food economist of the Bureau of Home Economics, Washington, in preparation for an educational program to contribute to the national health in time of emergency.

SEVERAL members of the staff of the Field Museum of Natural History are now engaged in national defense activities. Clifford C. Gregg, director of the museum, has been ordered into active service for a period of one year as a major of infantry in the United States Army. He has been assigned to staff duty at the headquarters of the Sixth Corps Area in Chicago. Museum men who have enlisted in the National Home Defense Guard of Illinois include Paul O. McGrew, paleontologist, and Bryan Patterson, assistant curator of paleontology.

DR. FRANKLIN S. HARRIS, president of Brigham Young University, has returned after a leave of ab-

sence of thirteen months during which he served as agricultural adviser to the Government of Iran. He helped to reorganize the Iranian Department of Agriculture. Part of his work was to establish a Bureau of Forestry. He also assisted in the solution of problems of irrigation, soils, transportation and colonization.

IN the address as president of the American Chemical Society of Dr. S. C. Lind, printed in the last issue of *SCIENCE*, on page 230, column 1, third paragraph, the second line from the bottom, the number 450 should be 4,500.

THE Clinical Congress of the American College of Surgeons will be held in Chicago from October 1 to 25.

MEMBERS of the Optical Society of America are invited to visit the following exhibits arranged by the industries of the city and the University of Rochester during the twenty-fifth annual meeting that will be held on October 3, 4 and 5. These include Eastman Kodak Company, Thursday, 2:00 P.M. A tour of the Kodak Research Laboratories including the Departments of Radiology, Sensitometry, Photometry, Microscopy, Photomicrography; Motion Picture Studio; Special instruments—Microdensitometer, Recording Spectrophotometer, Electron Microscope. The University of Rochester, Thursday, 9:30 P.M. Department of Physics—Cyclotron; Institute of Optics—Measurement of solar radiation, determination of ozone in the atmosphere. The Taylor Instrument Companies, Friday, 1:00 P.M. Luncheon followed by a trip through the plant. Inspection of manufacture of—Thermometers, Barometers, Compasses, Industrial Control Instruments. The Bausch and Lomb Optical Company, Friday afternoon. Plant visit and Instrument Display.

A LARGE collection of birds from Indo-China has been sent to the Smithsonian Institution by Dr. Joseph F. Rock, American botanist and ethnologist. The collection includes three specimens of the giant ibis. Dr. Rock was able to obtain a fine collection of the larger birds of the area. These included marabou storks, herons and other water birds. Among the smaller specimens are representatives of several species unknown until they were found by a Swedish expedition

in the same area within the past few years. The collection contained nearly eight hundred specimens.

At the beginning of the two hundred and fortieth year of the founding of Yale University, Silliman College, completing the group of ten undergraduate colleges, as originally planned, was opened on September 23. It is named for Benjamin Silliman, professor of chemistry and geology from 1802 to 1853. The building stands on the block bounded by College, Grove, Temple and Wall Streets. It includes the former Vanderbilt dormitories, given by the late Frederick W. Vanderbilt, of the Sheffield Scientific School class of 1876, and Byers Hall, given in memory of Alexander MacBurney Byers, of the Sheffield School, by members of his family. There are accommodations for 250 students, five resident fellows, rooms for visiting alumni, a dining hall, student common rooms and library. Professor Filmer S. C. Northrop, professor of philosophy and member of the Yale faculty for seventeen years, has been appointed master of Silliman College.

CORNELL UNIVERSITY has awarded forty-four John McMullen Regional Scholarships in Engineering to entering students from twenty-two states. The number is larger than usual this year because of a new ruling by the Board of Trustees giving the faculty committee authority to vary the stipends within limits in order to meet the specific needs of the applicants. The majority of the scholarships, however, carry \$400 a year during the entire four- or five-year course in the College of Engineering. These scholarships are awarded annually to secondary school graduates in 15 districts covering the United States except the State of New York, where other scholarships are provided. They are financed from the proceeds of the fund established by the late John McMullen, of Norwalk, Conn., "for the purpose of creating and maintaining free scholarships for the education of young men as engineers." Industrial scholarships, undergraduate scholarships and graduate scholarships are also supported from this fund, which now amounts approximately to \$2,000,000.

Nature states that the British home secretary recently announced in the House of Commons that he is willing to consider steps to enable alien men of science who are not released from internment to carry on their scientific activities or studies in internment.

DISCUSSION

RHESUS MONKEYS (MACACA MULATTA) FOR AMERICAN LABORATORIES

THE Bureau of Biological Survey issued permits for the following numbers of Rhesus monkeys to be imported into the United States mainly for scientific

laboratories: 1936: 12,992; 1937: 12,421, 1938: 15,851. Thus the actual average monthly importation from 1936 to 1938 inclusive was about 1,144, less mortality during shipment from India.

These figures show the magnitude and importance

of the trade in Rhesus monkeys for the many kinds of medical and other scientific research. The data also show that previous estimates were exaggerated which gave the numbers of monkeys imported as being between 30,000 and 50,000 per annum.

Assuming that these primate specimens are essential to the work of American investigators, two important questions arise: 1. Will this drain on the Rhesus monkey population seriously limit or in fact deplete the supply in India? 2. Since various embargoes have been imposed during recent years, is there a possibility of serious limitation which would curtail important scientific research?

I tried to find the answers to these questions when I was in India and the Far East during July, August and September, 1938, collecting a breeding stock for the Santiago Primate Colony of the School of Tropical Medicine, Puerto Rico and Columbia University.

A clear and unequivocal answer was found to the first question: The center of the trapping operations is in the district around Lucknow where Rhesus monkeys are ubiquitous, are found by the hundreds of thousands and are even considered as pests. Throughout great sections of India where no trapping is being done at present, Rhesus monkeys are found in large numbers. The bonnet macaques in Southern India constitute a further possible supply. The Government of India has at times caught animals in the farming plain districts and shipped them by carloads to forest districts in order to protect the crops of fruits and grains. Since the monkeys are very numerous, since they are prolific breeders and since, in the main, only juvenile animals are trapped for export, there is no question of extinction from trapping or even of serious limitation of the supply.

The second question is problematic. Monkeys in India are considered to be quasi-sacred by Hindus and Buddhists. These peoples resent their capture and export under the prevailing deplorable conditions and they are told that the monkeys are used for the "rejuvenation of decadent Westerners." The Society for the Prevention of Cruelty to Animals, both in America and India strives to prohibit this primate traffic. These pressure groups succeeded in having the following resolution adopted by the Government of India in 1937:

In exercise of the powers conferred by Section 19, the Sea Customs Act, 1878 (VIII of 1878), and in supersession of notification of the Government of India in Financial Department (Central Revenue) No. 23 Customs, dated the 3rd of April, 1937, the Central Government are pleased to prohibit the export of monkeys by sea or by land from British India during the period from 1st of April to 31st of August in each year.

Furthermore, the Coaching Tariff No. 11 of Indian

railways prohibits the carrying of monkeys during the stated season. Exceptions are made for the School of Tropical Medicine, London.

The season of prohibition is delimited to April through August because of the high temperatures prevailing in India at that time in consequence of which many monkeys suffocate during rail shipment to coast ports. No consideration has been given to the fact that specimens shipped from India during the late fall and early winter months arrive about 40 days later in the often severe cold winter of Boston or New York, where most freighters from India first dock. Nor has consideration been given to the climatic zones of the Red Sea or the Cape of Good Hope through which shipments must pass.

Even during normal peace times, shipping problems are acute. Animals are packed in bamboo cages for rail shipment to Calcutta or Bombay. During these journeys a high percentage (estimated 10-20 per cent.) are either killed in fights, severely wounded or die from suffocation or the lack of water. Most animal depots in the seaports are filthy and monkeys are exposed to the disease-carrying humans usually found around these depots. The conditions under which animals make the 40-day journey to the United States are in most cases equally deplorable. Most ship operators do not like to carry this live freight and many have rules against its transport. At present shipping space is in great demand and invariably officers of ships must receive heavy gratuities to get them to tolerate the nuisance of shipments of monkeys. Since no ships have adequate accommodations for live primates, they fare poorly and from 6 to 40 per cent. die on shipboard. In addition, shipping charges are deliberately made high in order to discourage shipment of these primates.

All those interested in bettering these conditions; the scientists who use them, the Hindus and Buddhists, the Society for the Prevention of Cruelty to Animals and conservationists, should have a common interest in working out feasible plans for providing near optimum shipping conditions for these monkeys. A study of the problem indicates that proper approach to the Government of India, to the shipping officials and to dealers would greatly improve conditions affecting this necessary import of primates.

It should also be noted that a small percentage of the Rhesus monkeys necessary for American laboratories could be supplied by breeding colonies such as the Santiago Primate Colony in Puerto Rico. There is no reason why some specimens can not be bred near centers of adequate food supplies in southern and southwestern United States. The possibility of substituting New World platyrrhine types for the Rhesus should receive due consideration, also.

Study of the problem leads me to suggest the following:

1. The entire problem should be more carefully studied by a government agency or foundation before serious shortages occur.
2. A diplomatic approach should be made to the Government of India through the United States Consulate in Calcutta, requesting their cooperation.
3. Trappers and shippers in India as well as importers in the United States should be licensed and compelled to meet certain stated requirements.
4. All Rhesus specimens leaving India should be tested for tuberculosis and the positive reactors eliminated.
5. A study should be made of the need for these primates and this demand should be coordinated throughout the year with trapping operations in India.
6. Agreements should be made with shipping lines which will handle this traffic so that they will provide shipping facilities and adjust their charges accordingly.
7. Shipments of monkeys should be accompanied by trained caretakers.
8. Shipments should be timed and routed taking into consideration the weather conditions prevailing at various times of the year and the effect on Rhesus shipments. The Red Sea should be avoided at certain seasons (after the Mediterranean is again open) and during severe winter weather, shipments could be sent to the West Coast or to Southern ports, *e.g.*, New Orleans, instead of Boston and New York.
9. An adequate balanced ration and not solely unhulled rice should be required for animals during shipment.
10. Rhesus monkeys could be purchased directly from reliable agents in India at a considerable saving to scientific laboratories.
11. Breeding colonies for a limited number of disease-free, selected, dated and conditioned specimens should be established in the United States or nearby in the Western Hemisphere.
12. Consideration should be given to the possibility of using the New World platyrrhine monkeys in experiments where they can be substituted for the Rhesus monkeys.

Assuming that a supply of Rhesus monkeys or of other *Macaca* is essential for American laboratories, some of these recommended steps would seem highly desirable if not imperative.

C. R. CARPENTER

SCHOOL OF TROPICAL MEDICINE,
COLUMBIA UNIVERSITY

MUSCA DOMESTICA AND HIPPELATES FLIES—VECTORS OF BOVINE MASTITIS

RECENT work at the Florida Agricultural Experiment Station on transmission of bovine mastitis shows that at least two species of insects, namely, the common housefly, *Musca domestica*, and frit flies or eye gnats, *Hippelates* spp. to be important vectors of the infection. Close observations made on diseased animals in

affected herds showed that *M. domestica* were persistent in their feeding habits at the teat orifice of lactating cows in the milking line and of cows corralled near the barns. They fed on waste milk accidentally spilled on floors during milking operations. *Hippelates* were noted to hover around the natural body openings of calves, yearlings, pregnant heifers and lactating cows. *Hippelates* fed on lacrimal fluid, fatty body secretions, milk droplets accidentally spilled on the feet and on secretion at the tip of the teat of animals in herds where mastitis has prevailed. Structural characters, breeding habits and feeding activities of *M. domestica* and *Hippelates* flies aroused suspicion that these insects could serve as ideal vectors of mastitis.

Exposure tests were made to ascertain the possible relation these species might have to udder infection by their feeding habits at the teat orifice. The insects were taken from herds where mastitis has prevailed. In some instances alternate feedings on infected material and the teat orifice were made, while in other instances the teat orifice was exposed to insects taken directly from premises where mastitis prevailed. Mastitis developed in each of the experimental animals by the exposure technique employed. The type of udder infection, whether temporary or permanent, depended upon several factors. Active infections developed where the udder secretion was allowed to remain in the quarter as occurs naturally during the drying-off period prior to calving. Under natural conditions *M. domestica* and *Hippelates* fed simultaneously at the teat orifice of animals in corrals and many exposures were effected throughout the day during the insect season. While this work points out importance of insect transmission of bovine mastitis and opens up new fields of investigation it does not convey the idea that mastitis may not be transmitted by other means. Since *Hippelates* have previously been incriminated in the transmission of conjunctivitis and yaws (*framboesia tropica*) in humans it would not seem unreasonable to suspect these insects serve as vectors of other infections such as Brucellosis in cattle via the conjunctivae, mouth, teat orifice, vagina and skin. Buchli has shown these routes to be the portals of entry of *Brucella abortus* in cattle.

D. A. SANDERS

FLORIDA AGRICULTURAL EXPERIMENT STATION

EVIDENCES OF PLEISTOCENE CURRENTS IN PENINSULAR FLORIDA

THE Aero Service Corporation in Philadelphia have recently completed, on a scale of 1:40,000, an aerial survey of the southern third of the peninsula of Florida. The photographs had been assembled on a rough mosaic basis on great boards, and matched with a remarkable degree of accuracy. Southeast of Lake Okeechobee the small lagoons were arranged along

lines of N 30 W. In the area west and northwest of Lake Okeechobee the lagoons and probably sand ridges were arranged along lines of N 45 W. Southwest and west of Miami the lines were arranged in broad sweeping curves convexed toward the east, approximating the curve of the Florida Keys.

The impression produced was very striking. The probable explanation is that this arrangement is due to currents, or currents and winds acting together during Pleistocene time, when all of this portion of Florida was covered by shallow sea.

ROY E. DICKERSON

PHILADELPHIA, PA.

THE USE OF THE TERMS POLYGAMY, POLYGYNY AND POLYANDRY

The term polygamy is frequently used as a synonym

of polygyny in zoological writings. Polygamy, however, is an inclusive term, referring to the custom of having more than one mate, and includes both polygyny and polyandry. Since there is a definite meaning and a need for each of the three terms, it seems most desirable to stop the degradation of meaning and use the terms as defined in Webster's New International Dictionary, 1935:

Polygamy. The custom or practice of having a plurality of wives or husbands at the same time.

Polygyny. The mating of one male with several females, in certain animals, as fur seals.

Polyandry. The possession by a woman of more than one husband or mate at the same time.

DAVID E. DAVIS

BIOLOGICAL LABORATORIES,
CAMBRIDGE, MASS.

SCIENTIFIC BOOKS

STATISTICAL MECHANICS

The Principle of Statistical Mechanics. By RICHARD C. TOLMAN. Oxford University Press, 1939.

THIS new book of Tolman will be welcomed by every one interested in the fascinating field of statistical mechanics. Since an earlier book by Professor Tolman on the same subject, in the reviewer's opinion, remains one of the best introductory texts, one knew what to expect. The new book, however, far from being in any way a new edition of the older work, has a completely different character. Its purpose is to elucidate in detail the principles of the subject, especially in so far as they have been influenced by the development of the quantum mechanics. Except in the book of Von Neumann (which lies beyond the mathematical horizon of most physicists), this task had never been attempted. And this attempt alone makes it an important and useful book. In fact, it seems a pity that Tolman has not restricted himself to this sole task. In addition his book contains a straightforward text of the quantum mechanics (Chapter VII) and a discussion of the usual kind of applications (in Chapters X and XIV). These sections could have been omitted without loss to the main argument. They are quite satisfactory in themselves, but they are addressed, so to speak, to a different audience from that of the rest of the book.

The main part of the book may very well be compared with the famous article by P. and T. Ehrenfest in the "Enzyklopädie der Mathematischen Wissenschaften." There the principles of statistical mechanics were analyzed on the basis of the classical mechanics. Ehrenfest was able to show that many additional assumptions had to be made in order to explain the

second law of thermodynamics. The clarity of his exposition has had a strong influence on the further development of the subject. And before going any further it may be said that Tolman's book reaches the same high standard of lucid and careful exposition. The two treatments of course exhibit several differences. The most important one is the difference in attitude with regard to the work of Gibbs. Ehrenfest has always held the opinion that Gibbs had only simplified and systematized the ideas of Boltzmann. Tolman, on the other hand, considers the Gibbsian concept of the canonical (and grand-canonical) ensemble as absolutely fundamental. He of course admits that for its justification one has to make certain assumptions, but he considers these as inherent to any kind of statistical approach. Furthermore, he tries to show that essentially the *same* assumption (the hypothesis of equal *a priori* probabilities) has to be made in the classical as in the quantum statistics. The close analogies which exist between these two fields are very striking indeed. Tolman has emphasized these analogies by making the part of the book devoted to the classical statistics (Chapters III till VI) completely parallel to the part dealing with the quantum statistics (Chapters IX till XII). Even the wording is sometimes almost the same. Both parts culminate in the discussion of the H-theorem, which is thus given the central position it deserves.

All this surely is very illuminating. However, the reviewer must admit that the analysis of Tolman has not quite convinced him of the validity of the Gibbsian point of view, although as an old pupil of Ehrenfest, he may perhaps be prejudiced.

Since this is not the place for a detailed discussion, the reviewer will try to express in general terms his

objections or perhaps better his feelings of discomfort. It is clear that the main difficulty lies in the explanation of the time-dependent processes in statistical physics. In fact, the fundamental problem is always to reconcile the reversible laws of mechanics with the apparent irreversibility of most of the phenomena which occur in nature. With regard to the theory of the properties of matter in equilibrium, there is in practice no difference of opinion. There are different ways of interpreting and justifying the canonical ensemble. But they all lead to the same general method for calculating the thermodynamic properties of a system, when the molecular constitution and the laws of interaction between the molecules are known. Of course this general method can not usually be carried out because of the great mathematical difficulties. And it is therefore perhaps not *quite* sure whether all the equilibrium properties can in principle be explained in this fashion. There is, for instance, the question of the existence of different phases of the same substance and the corresponding problem of the phase transitions, like condensation and melting. There are only the beginnings of an understanding of the liquid state. And so one can go on; the strict theory of all these matters, starting from first principles, is still lacking, although several interesting attempts have been made. Tolman does not consider these questions. Their critical discussion would doubtless have increased the book beyond all measure. They should have perhaps been mentioned at least, because they are (or better should be) essential applications of the general methods, describing the properties of systems in the equilibrium state.

However, as said before, the main difficulties lie in the explanation of the phenomena in systems *not* in the equilibrium state. And the first problem is to show that the equilibrium state, as described by the canonical ensemble, is always reached in time. This is what the x-theorem tries to do, and it is here that the differences of opinion occur. One has to distinguish between the original H-theorem of Boltzmann,

which only holds for ideal gases, and the generalized H-theorem of Gibbs, which deals with the ensemble for an arbitrary system. The proofs for these two theorems have quite a different character. For gases one can actually write down an expression for the rate of change of the function H, so that one not only shows that the equilibrium state is always reached in time, but one has also an idea how long it will take. One can estimate the relaxation time. In the background, so to speak, there is also the exact theory of the transport phenomena (heat conduction, diffusion, etc.), which gives a satisfactory explanation of at least some of the non-equilibrium phenomena in gases. The situation is quite different for other systems, as in the cases of liquids and solids. Even if one is convinced by Gibbs's proof that the equilibrium state is always reached in time—and the analysis of Tolman has made the proof really quite convincing—still one has no way of estimating the relaxation time. As a result, there does not exist a strict theory, say, for the viscosity of a liquid, and in the reviewer's opinion this is *not* only due to mathematical difficulties, but it is even not clear how to formulate the problem mathematically, supposing always that the molecular constitution of the liquid and the interaction laws between the molecules are known.

This is really the main reason why the reviewer feels dissatisfied with the treatment of Gibbs and Tolman. Ehrenfest used to say that the book of Gibbs was too "smooth"; that it gave too much the impression that all problems in statistical physics were in principle solved when one could believe the classical mechanics. And the same kind of impression may be gotten from Tolman's book. This, of course, does not detract from its value. But it is the reason why the reviewer has tried to emphasize the questions which still remain open. Statistical physics has been rather neglected by the theoretical physicists, and only the simple problems have really been solved.

GEORGE E. UHLENBECK

UNIVERSITY OF MICHIGAN

SPECIAL ARTICLES

THE AUTONOMIC BASIS OF EMOTION¹

CANNON² has stressed the significance of the sympathetico-adrenal discharge in emotion in a number of important papers. He attributes less significance to discharges via the parasympathetic system, although he admits that under conditions of great fear signs of parasympathetic discharge may be present together

with the well-known sympathetico-adrenal syndrome. This latter phenomenon he explains by a lack of "orderliness of central arrangement" so that the "opposed innervations no longer discharge reciprocally but simultaneously and then the stronger member of the pair prevails." Several authors (Kling,³ Bekhterev,⁴ Bergmann⁵ and others) have shown that, at least in the

¹ Aided by a grant from the John and Mary R. Markle Foundation.

² W. B. Cannon, "Bodily Changes in Pain, Hunger, Fear and Rage," New York, 1929; and "The Wisdom of the Body," New York, 1939.

³ C. Kling, *Psychological Review*, 40: 368, 1933.

⁴ V. M. Bekhterev, "Feelings and Emotions." Edited by M. L. Reymert, Clark University Press 1928, p. 270.

⁵ G. Von Bergmann, *Funktionelle Pathologie*, Berlin, 1936.

human, vagal discharges frequently accompany emotional processes.

It was shown recently by ourselves⁶ that the inhalation of low oxygen as well as the administration of metrazol produces in rats definite signs of a simultaneous vago-insulin and sympathetico-adrenal discharge. The predominance of the sympathetico-adrenal system explains the fact that in normal animals anoxia and metrazol cause a rise in the blood sugar. After elimination of the sympathetico-adrenal system these factors lead to a characteristic hypoglycemia. If, however, the vagi are cut below the diaphragm this hypoglycemic effect is absent. These experiments make it probable that conditions such as sham rage and rage which in the normal cat lead to marked discharges over the sympathetico-adrenal system may in animals in which the effects on this system have been eliminated reveal discharges over the vagus, leading to an increased secretion of insulin. Such experiments seem to be of great interest not only for the theory of emotion but also as a contribution to the still disputed problem in how far the vagus contributes to insulin secretion under physiological conditions.

In the first group of experiments the well-known syndrome of sham rage was produced by stimulating the left mamillary body of the hypothalamus in lightly narcotized cats by means of faradic currents. The Horsley-Clarke stereotaxic instrument was used in these experiments. Such a stimulation leads regularly to an increase in blood sugar due to sympathetico-adrenal discharge (Karplus and Kreidl,⁷ Ranson⁸ and collaborators). If the adrenals are eliminated and the liver is denervated, such stimulation, although still accompanied by the marked sympathetic signs of sham rage, is accompanied by a reversible fall in blood sugar. If, however, the experiment is repeated in such animals after the vagi had been cut the result of stimulation is now a slight rise in blood sugar which is much weaker than that observed in animals with the sympathetico-adrenal system intact. It seems highly probable that this latter rise is due to a secretion of sympathin (*cf.* Partington⁹). The fall in blood sugar observed in the first part of the experiment must be attributed to an increased secretion of insulin mediated by the vagi.

These experiments are confirmed in a second group of experiments in which the spinal cord was sectioned below the sixth cervical segment, and hypothalamic stimulation was carried out eighteen hours later. Here again it was found that sham rage produced hypogly-

cemia when the vagi were intact, but a slight delayed rise in blood sugar occurred on hypothalamic stimulation after vagotomy.

Another group of experiments was conducted on cats in which again the spinal cord was sectioned at the sixth cervical segment in order to eliminate the effect of central sympathetic discharges on the sympathetico-adrenal system. When such cats were confronted with a barking dog, whereby a typical rage reaction was elicited, the blood sugar fell in spite of marked signs of rage such as pupillary dilatation, increased respiration, unsheathing of the claws, etc. If, however, the experiment was repeated after the vagi had been cut below the diaphragm the result of the rage reaction was now a slight increase in blood sugar. Whether this increase is due to sympathin or to some stimulation of the hypophysis remains to be investigated. The experiments have clearly proven that the natural emotional process of rage as well as sham rage induced by hypothalamic stimulation lead to a simultaneous discharge over the vago-insulin and sympathetico-adrenal system.¹⁰ It is obvious that it will be very important to study the evidence of such vago-insulin action under conditions of emotional disturbances.

SUMMARY

(1) It is shown that hypothalamic stimulation in cats, with faradic currents eliciting the syndrome of sham rage, produces after the elimination of the sympathetico-adrenal system a hypoglycemia when the vagi are intact. After bilateral vagotomy the stimulation results in a slight and delayed rise in blood sugar.

(2) If in cats in which, due to a sectioning of the spinal cord at the sixth cervical segment, the effect of central discharges on the sympathetico-adrenal system is eliminated, a rage response is elicited by a barking dog it produces a fall in blood sugar. The sectioning of the vagi below the diaphragm abolishes this reaction.

From these experiments it is concluded that the normal emotional process as well as the sham rage reaction is characterized by a simultaneous discharge over the vago-insulin and sympathetico-adrenal system. The latter predominates in the normal animal and masks the effects on the former.

E. GELLHORN

R. CORTELL

J. FELDMAN

COLLEGE OF MEDICINE OF THE
UNIVERSITY OF ILLINOIS,
CHICAGO

⁶ E. Gellhorn, paper read at Cincinnati meeting of the American Psychiatric Association, May, 1940.

⁷ J. P. Karplus and A. Kreidl, *Arch. ges. Physiol.*, 135: 401, 1910.

⁸ S. W. Ranson and H. W. Magoun, *Ergebn. Physiol.*, 41: 56, 1939.

⁹ P. P. Partington, *Amer. Jour. Physiol.*, 117: 55, 1936.

¹⁰ It is interesting to note that Harris and Ingle (*Am. Jour. Physiol.*, 120: 420, 1937) observed in adrenalectomized rats a fall in blood sugar under conditions of fright which evoked a hyperglycemic effect in the control animals. These authors failed, however, to see the significance of their findings and the role of the vagus in insulin secretion. They attribute their results to an artefact.

A PRELIMINARY NOTE ON THE EXTRACTION OF A CARCINOGENIC FACTOR FROM PRIMARY HUMAN MAMMARY CANCER¹

THE following are the preliminary results of an experiment in which extracts of two human mammary cancers produced tumors at the site of injection in experimental animals.

In reviewing the extensive work that has been done on the hydrocarbon carcinogenic agents, their chemical and physical properties and relation to the normal sterols of the animal body, the common property of the fat solubility seems to stand out as a characteristic that might also be common to a hypothetical human carcinogenic factor. If such a factor exists, it would likely be extractable by fat solvents, and the site of an early primary growth would serve as an indicator of the region of greatest concentration locally. Since the solubility of the factor was unpredictable, and it seemed likely that it would be present in minute quantity, the use of several solvents would increase the chance of complete extraction.

With the above assumptions in mind the following experiment was performed. On August 23, 1939, a small, 2 cm × 2.5 cm, scirrhous type carcinoma with axillary node involvement was removed by right radical mastectomy. After small blocks of tissue had been excised for fixation and microscopical examination, the primary nodule with its immediately surrounding fatty tissue was dissected free of the remainder, ground to a hash, covered with cold acetone and stored in a refrigerator. Acetone was used to serve both as a solvent and as a dehydrating agent to prepare the tissue for later ether extractions. The material was then placed in a Soxhlet extractor and extracted exhaustively at the lowest possible temperature with the following solvents in this order: 1. acetone, 2. ethyl ether, 3. petroleum ether (B.p. 35–60° C.), 4. absolute ethyl alcohol. In an attempt to minimize chemical change, this order was maintained to remove as much fat soluble matter as possible before the higher temperature of the alcohol extraction. Separate portions of the hash were then each extracted with each solvent for at least 24 hours. The solvents were then removed by distillation at reduced pressure. The fractions were then combined for injection into experimental animals, advantage having been taken of the neutral fat as a solvent. This extract was designated H.M.Ca. Extract No. 1.

On October 10, 1939, a second human scirrhous carcinoma was obtained following a left radical mastectomy. The primary nodule measured 4.5 cm × 4.5 cm × 1.5 cm and metastatic cancer involved the axillary nodes. This tumor was extracted by an iden-

tical procedure and the final extract was designated H.M.Ca. Extract No. 2.

The experimental animals used were virgin female mice one month old of Little's C57 black low tumor strain. The strain has been maintained pure by brother-sister mating only and no spontaneous tumors have occurred in 200 control animals.

On September 12, 1939, 0.2 cc of H.M.Ca. Extract No. 1 was injected subcutaneously into the region of the left hind-most breast of 4 virgin females. Subsequent injections of 0.2 cc, alternating left and right hind-most breast regions, were given on October 11, 1939, November 21, 1939 and December 4, 1939. To avoid any continuous effect of whatever estrogenic substance the extract might contain, no further injections were given. These animals were each allowed a single pregnancy during the injection period. No animal was injected during lactation.

H.M.Ca. Extract No. 2 was first injected into the region of the left hind-most breast of 5 virgin females on November 17, 1939. One subsequent injection was given in the region of the opposite breast on December 3, 1939. All of these animals were kept virgin throughout the experiment.

The first tumor appeared on June 20, 1940, 282 days after the first injection of H.M.Ca. Extract No. 1. A hard subcutaneous nodule 0.5 cm in diameter was found at the very site of the first injection. This mass grew rapidly and on July 1, 1940, had reached 2 cm × 2.5 cm in size. The animal was sacrificed and a portion of the tumor was transplanted into 4 mice of the same strain. After microscopical preparation of the remainder, the tumor was found to be a rapidly growing spindle cell sarcoma. No gross metastases were found, but microscopically the mass extensively invaded the abdominal wall. The transplants grew rapidly in all of the animals and resulted in a 2 cm ulcerating mass by the twentieth day. Three of the animals died from the effects of the transplant between the twentieth and twenty-sixth day. On the twenty-sixth day the fourth animal, obviously dying, was sacrificed and the tumor was retransplanted. In each case an equally large internal mass was found in the abdominal cavity where the subcutaneous transplant had invaded the abdominal wall. No gross metastases were found in other regions of the body.

On July 3, 1940, 229 days following the first injection of H.M.Ca. Extract No. 2, a tumor appeared in this series of animals. This tumor also appeared at the very site of the first injection. It was allowed to grow until July 22, 1940, when it had reached 1.5 cm in size. A portion of this was transplanted into 4 animals and grew rapidly. Microscopical examination again revealed a spindle cell sarcoma. The mass had invaded the muscle to which it was adherent, but no gross metastases were found.

¹ From the Laboratory for Surgical Research, Stanford University Medical School.

To date, no other tumors have appeared in either series of animals.

Apparently, for the first time, a factor has been extracted from primary human cancer which is capable of producing tumors in an experimental animal. Further trials of the above experiment are now under way, in addition to the obvious control experiments that will be necessary to establish this finding. Also, an attempt is being made to isolate the active factor from the pooled extracts of several human cancers. These results will be reported when they are completed.

JOHN F. MENKE²

STANFORD UNIVERSITY HOSPITAL

INSECT LIFE WITHOUT VITAMIN A

IN a series of earlier studies¹ it was found that *Blattella germanica* L., the ordinary cockroach, could grow to maturity upon a synthetic diet of purified casein, starch, salt mixture and yeast or yeast extract. Since this diet was very low in vitamin A, this species must either have synthesized this factor or have had no need for it. Inasmuch as vitamin A seems essential for all the higher vertebrates that have been studied, it is interesting that it may play no part in the life of one or possibly many species of insects.

A new series of experiments was devised to check the earlier results showing no dietary need for this vitamin. The work was then extended still further to determine whether or not the cockroach could synthesize this factor within its body when fed diets devoid of vitamin A or its precursor carotene. The stock diet that has been in use for many years by us for producing cockroaches is a mixture of equal parts of whole wheat flour and dried skimmed milk. This diet was exposed to hot air for six hours at 115° C. to

destroy any carotene. The young cockroaches, started two days after emerging, grew better upon this heat-treated diet than upon the original. The purified diet deficient in vitamin A and used in the usual assay procedure for vitamin A was then tested as a stock diet. All these studies indicated that the cockroach could thrive upon diets that are so deficient in vitamin A that they will not support the growth of rats.

The next step to determine if this insect could carry on its body functions without vitamin A consisted in producing large numbers of the insects upon an A-free diet, extracting the fat from these insects and testing this fat for this vitamin.

By the use of large cages 2.5 kilograms of live cockroaches were produced in the course of ten months. These were reared upon the vitamin A-free diet used in the U. S. P. method for the vitamin assay with rats. From these insects were extracted very carefully in the cold 150 grams of oil. This oil was tested colorimetrically for vitamin A but gave only a negative test. It was then fed to rats in accordance with the usual procedure for the assay of vitamin A. Levels of 0.1 and 0.01 grams were fed daily in this assay. Neither level gave any indication of containing vitamin A. In the same assay the reference cod liver oil gave the usual response in growth and prevention of eye symptoms.

From these results it is evident that the cockroach needs no vitamin A in its diet and that its body can function normally throughout its life cycle without this vitamin. Therefore vitamin A is not of universal importance in the life of animals.

R. E. BOWERS

STATE NORMAL SCHOOL,
CORTLAND, N. Y.

C. M. McCAY

CORNELL UNIVERSITY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A DIFFERENTIAL METAL BELLOWS MANOMETER FOR THE MEASUREMENT OF BLOOD FLOW

THE differential rubber membrane manometer described in an earlier report for the measurement of blood flow by differential manometry¹ has been replaced by a pair of metal bellows manometers, arranged to record mechanically the difference in their pressure readings. The calibration of the manometer couple in this arrangement has remained constant over a period of eight months in almost daily use.

The bellows is a deeply corrugated thin-walled cylinder, which elongates under application of internal

pressure.² The most flexible small bellows obtainable has an outside diameter of 25 mm and a length of 30 mm. Without load, it responds to internal pressure with elongation at the rate of approximately 0.04 mm for 1 mm Hg in roughly linear fashion up to at least 200 mm Hg. To adapt the bellows for differential manometry, a pair of them was mounted on suitable bases (Fig. 1, a) and clamped in position with their movable faces apposed so that each bellows exerted its full thrust against the other. Magnified mechanical recording of the movement at the apposed faces was accomplished by inserting between the faces a short sleeve (Fig. 1, b) bearing a rod onto which the short arm of a recording lever was slotted (Fig. 1, c). The

² The courtesy of the Fulton Sylphon Company, Knoxville, Tenn., who supplied the bellows from special stock, is gratefully acknowledged.

² Finney-Howell fellow in cancer research.

¹ C. M. McCay, *Physiol. Zool.*, 11, 89, 1938.

¹ Hampden Lawson and J. P. Holt, *Jour. Lab. and Clin. Med.*, 24: 639, 1939.

sleeve was cut out as shown in the sketch, and fastened to the free face of each bellows with a small amount of solder. Maximum range is secured for the couple by mounting the bellows under minimum compression. The fulcrum which carries the recording lever is adjustable on the short rod *d*. The recording lever and its axle are shown only in the lateral view in Fig. 1.

When coupled in this fashion, the elongation of each bellows for a given rise in pressure is reduced by one half, pressure in the other member of the pair remaining constant. Thus, with the diameter and flexibility given above the volume change for a pressure rise of 100 mm Hg is approximately 0.87 cc. Under most conditions the time required for the displacement of

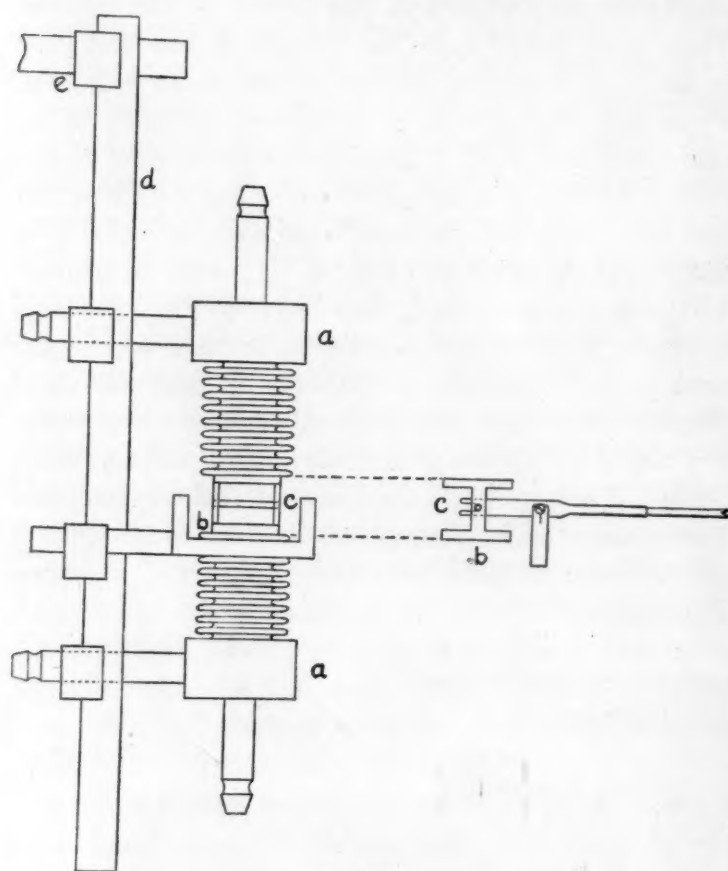


FIG. 1

this volume of fluid does not constitute a serious error. Unless pressures high enough to produce lateral deformation are employed, the behavior of the firmly joined apposed faces resembles that of a single elastic membrane, in response to pressure differences in the two members of the couple. Equal pressure increases in either member, pressure in the other remaining constant, will produce equal and opposite movements of the writing point from the zero line, regardless of differences in the separate flexibility of the two bellows. Furthermore, since fluid displacement for a given pressure change is equal in the two members, resistance to flow anywhere in the system has the same effect as resistance anywhere else.

The use of this type of manometer as a flow-meter for arterial blood flow was described in the earlier report. Water is used for filling the bellows and tub-

ing, rather than citrate solution, as the latter corrodes the metal bellows. After cannulation and filling of the apparatus is complete, 5 per cent. chlorazol fast pink solution is injected into the cannulae and adjacent tubing as an anticoagulant. In filling the lower bellows, air is evacuated by rotating the couple on the rod *d* in the clamp *e* until the lower bellows is uppermost.

With arterial pressure acting on both bellows, there is usually a fairly wide swing of the writing point with each pulse wave, due to delayed arrival of the wave at the lower cannula. Up to a frequency of about 40 per min. in hydrostatic systems, equal but asynchronous pulsating pressures in the two bellows produce equal oscillations of the writing point about the true mean. With higher frequencies, such as occur in the arteries, there may be an error as great as 2 mm Hg in reading the true mean.

When the constricting clamp is placed on the artery between the two cannulae to permit the use of the apparatus as a flow-meter, the pulse wave as well as mean pressure in the lower bellows is reduced, and the now weakly opposed waves in the upper bellows produce large oscillations of the pointer. The legibility of the record may be improved by damping these with a screw clamp applied to the tubing leading to the upper bellows. The reading of the mean pressure difference is not affected by such damping.

The force acting at the apposed faces is approximately 5.85 gm for a pressure difference of 1 mm Hg. This permits the use of magnifying recording levers, giving 50-100 times magnification on the record. With a light lever giving a magnification of approximately 100 times, the apparatus in use has a period of 0.3 sec. Since this is of the same order as the natural period of most mercury manometers, the apparatus can indicate flow changes with such cyclic circulatory phenomena as can be recorded with a mercury manometer. The accuracy with which it records these is about the same as the accuracy of the usual laboratory mercury manometer in indicating pressure changes.

HAMPDEN LAWSON

UNIVERSITY OF LOUISVILLE
SCHOOL OF MEDICINE

BOOKS RECEIVED

- CURTMAN, LOUIS J. and SYLVAN M. EDMONDS. *Calculations of Qualitative Analysis*. Pp. vii + 156. Illustrated. Macmillan. \$2.00.
JONES, H. SPENCER. *Life on Other Worlds*. Pp. x + 299. Illustrated. Macmillan. \$3.00.
MERRILL, PAUL W. *Spectra of Long-Period Variable Stars*. Pp. ix + 107. 6 plates. University of Chicago Press. \$2.50.
STAIG, ROBERT A. *The Fabrician Types of Insects in the Hunterian Collection at Glasgow University. Part II*. Pp. x + 164. 59 colored plates. Cambridge University Press, Macmillan. \$7.60.